In the Specification

PAGE 1, after the heading "BACKGROUND", insert the following new text:

-- Field of the Invention

This invention relates to electrical contacts that are treated to maintain minimal contact resistance.

Discussion of the Known Art --

PAGE 1, second paragraph, correct the paragraph as follows:

Electrical contacts are generally made from copper or copper alloys due to their relatively high electrical conductivity. ~~However, copper~~ Copper alloys oxidize easily, however, which reduces the integrity of ~~the~~ their electrical contacts. Therefore, copper electrical contacts are ~~generally~~ usually coated with a layer of material that oxidizes less readily than copper. One example of such a material is tin, which is typically applied as a coating ranging in thickness from about .0001 to about .0003 inch. In addition to preventing the copper contacts from oxidizing and thereby maintaining the electrical integrity of the contacts, the tin coating also imparts solderability if needed for the application.

PAGE 2, after the heading "SUMMARY", delete the three paragraphs and substitute the following new paragraph:

-- According to the invention, a method of treating an electrical contact member made of copper or a copper alloy includes electroplating a barrier layer on a

contact surface of the member wherein the barrier layer is selected from the group consisting of cobalt, cobalt-nickel alloys, cobalt-tungsten alloys, and cobalt-nickel-tungsten alloys; forming the barrier layer to a thickness in the range of from about 0.00001 inch to about 0.0001 inch, and which thickness is sufficient to prevent the electrical contact resistance of the treated contact member from increasing above a given limit over a given period of time at a given temperature; and coating an outer finish layer over the barrier layer, wherein the finish layer is selected from the group consisting of tin, gold, palladium, platinum, silver, and alloys thereof, so that the given limit of electrical contact resistance of the treated contact member is about 10 milliohms at 100 grams contact force, the given period of time is at least 1000 hours, and the given temperature is at least 150 degrees C. --

PAGE 2, after the first paragraph under the heading "BRIEF DESCRIPTION OF THE DRAWINGS", amend the text as follows:

FIG. 1 is a schematic illustration of a prior art metallization scheme; ~~and~~

FIG. 2 is a schematic illustration of one embodiment of the ~~metallization scheme~~ inventive electrical contact with a nickel, cobalt, tungsten ~~and~~ or rhodium barrier layer[[.]]; and

FIG. 3 is a flow diagram illustrating steps of the inventive method.

PAGES 2 to 4, amend the paragraphs after the heading "DETAILED DESCRIPTION OF THE INVENTION", as follows:

The present invention is directed to an improved barrier layer for electrical contacts, more specifically for electrical contacts formed ~~using relatively~~ of low resistance substrate materials such as copper or copper alloys. FIG. 3 illustrates steps

for treating an electrical contact according to the invention.

The improved barrier layer maintains the integrity of the contact resistance over time. As such, the barrier layer of the present invention preserves the low contact resistance of the substrate material by minimizing interactions between the substrate material, the barrier layer and~~, in another embodiment, the~~ a finish coating which ~~include~~ includes, but ~~are~~ is not limited to, Sn and precious metals such as Au. ~~In one embodiment, the~~ The improved barrier layer of the present invention has a resistivity somewhat higher than the substrate material, relatively low diffusivity in the substrate material, relatively low solid solubility in the substrate material, and relatively high intrinsic electrical conductivity. In addition to maintaining the integrity of the electrical contact and preventing degradation of the contact resistance, the barrier layer ~~should also have~~ also preferably has a low friction coefficient.

~~In another embodiment, the improved~~ The barrier layer may be electroplated on the substrate at relatively high speed and with relatively high efficiency. ~~In a further embodiment, in addition, the~~ The barrier layer is preferably composed of materials that are precious metal-free and, thus, of relatively low cost. ~~In yet another embodiment, the~~ The barrier layer adheres well to tin or gold, is relatively hard, and is anti-galling for low insertion force. " Anti-galling," as used herein, means preventing or reducing plastic deformation at ~~the~~ an interface ~~when~~ between two surfaces ~~are~~ when sliding against each other, retarding further movement. "Anti-galling," as used herein with reference to electrical contact applications, means reducing the insertion force of coated connectors ~~into~~ when mated with soft tin coated female ~~adaptors~~ connectors.

Materials that have been found suitable for the barrier layer of the present invention include rhodium, cobalt and cobalt alloys such as cobalt-nickel, cobalt-tungsten, cobalt- nickel-tungsten and nickel-tungsten. Although[[,]] copper also has a relatively low diffusivity in tungsten, tungsten cannot be electroplated as elemental tungsten. It can be plated as a tungsten alloy such as Co-W, Ni-W or Co-Ni-W, with a relatively high efficiency.

One embodiment of an electrical contact 10 is illustrated schematically in cross-section in FIG. 2. As shown in FIG. 2, electrical contact 10 includes a substrate 12, a strike layer 14, and a barrier layer 16. Although not always necessary, ~~in some embodiments~~ an outer coating or finish layer 18 ~~may be~~ is preferably included. ~~In one embodiment, substrate~~ Substrate 12 may be any low resistance material~~. In a preferred embodiment, substrate 12 is~~, preferably copper. As used herein, "copper" refers to copper and alloys of copper.

~~In one embodiment, electrical~~ Electrical contact 10 ~~has~~ also preferably exhibits a contact resistance of less than about 10 milliohms, more preferably less than about 5 milliohms, and in a particularly preferred embodiment, less than about 2 milliohms.

Strike layer 14 may be formed from a ~~metal~~ metallic material including, but not limited to, gold, silver, platinum, palladium, and combinations thereof. The purpose of strike layers, which are generally known in the art, is ~~to~~ among other things to provide a suitable surface on which to apply a successive layer, which ~~is~~ in the present embodiment is the barrier layer 16. ~~In an embodiment, strike~~ Strike layer 14 is preferably very thin, particularly having a thickness ranging from about 5 microinch to about 20 microinch, more particularly about 10 microinch.

~~The barrier layer 16 of the present invention can be any of the afore-mentioned barrier materials. In one embodiment, barrier~~ Barrier layer 16 is preferably composed of ~~a barrier material of~~ cobalt or an alloy of tungsten such as nickel-cobalt-tungsten. ~~In a further embodiment,~~ The barrier layer 16 may have a thickness ranging from about 0.00001 inch to about 0.0001 inch, more particularly about 0.00005 inch.

~~In a further embodiment, the~~ The electrical contact ~~may include~~ 10 preferably has an outer layer or finish coating 18. In one embodiment, outer layer 18 is composed of a material having a relatively low tendency for oxidation ~~tendency~~ and ~~that~~ is usually solderable. For example, suitable materials for outer layer 18 include, but are not limited to, tin or precious metals such as gold, silver, platinum,

palladium and ~~combination~~ alloys thereof.

~~In one embodiment of the present invention for forming the electrical contact, a suitable substrate is utilized such as copper or a copper alloy. In one specific embodiment, the~~ The substrate 12 is preferably subjected to a first surface treatment to remove any surface oxidation and, if desired, a second surface treatment to activate the surface in preparation for electroplating the barrier layer. ~~The~~ As mentioned, such surface activation may be, for example, depositing ~~a~~ the strike layer, which ~~is known in the art. Suitable strike layers~~ may include, for example, nickel or silver.

~~In a further embodiment, after~~ After the surface treatment(s) is applied, the substrate ~~may be~~ 12 is immersed in an electroplating bath in order to deposit the barrier layer ~~of the present invention~~ 16 directly on the substrate 12 or on the strike layer 14. ~~In yet another embodiment, after~~ After depositing the barrier layer, ~~if desired,~~ ~~an~~ the outer layer ~~may be~~ 18 is deposited, for example by electroplating, although other methods known to those of skill in the art may be used, including evaporation, sputtering, and resistance evaporation. ~~In yet a further embodiment~~ For example, tin may be deposited as the outer layer 18.

Suitable plating baths for the barrier layer 16 include cobalt sulphamate solutions, sodium tungstate solutions, cobalt and nickel sulphamate and sodium tungstate solutions, and cobalt sulphate, nickel sulphate and sodium tungstate solutions. The electroplating baths may additionally include additives, brighteners, anti-pitting additives, and the like. If desired or necessary, the pH of the electroplating bath may be adjusted and/or buffered as known to those of skill in the art.

PAGE 10, amend the first to the last paragraphs as follows:

For example 5B, following the application of the barrier coating, the samples were finish coated with a 5 micro-inch layer of gold. For example 5C,

following the application of the barrier coating, the samples were finish coated with a 40-50 micro-inch layer of Sn-Pb alloy. All coating thickness values were measured using an XRF technique.

For examples 5A -5C, the effectiveness of the barrier ~~coating~~ layer 16 was evaluated by measuring the change in contact resistance values when exposed to normal application temperatures over time. The contact resistance test method utilized was ASTM B 667-92 ("Standard Practice for Construction and Use of a Probe for Measuring Electrical Contact Resistance"). In order to simulate this "aging" process, accelerated aging conditions were employed -- samples were aged in air at ~~150F~~ 150 degrees C and ~~250F~~ 250 degrees C for various times and the contact resistance values were measured at 100 gms.

The change in contact resistance is caused by a number of interactions including: diffusion of the Cu substrate through the barrier layer 16 and its subsequent oxidation; formation of intermetallic compounds, particularly Cu-Sn intermetallics for the case of Sn or Sn-Pb finish coatings 18; interdiffusion of the barrier layer 16 and the finish coatings thus forming solid solutions or intermetallic compounds and oxidation of the barrier layer 16. A more effective barrier ~~coating~~ layer is ~~a barrier coating~~ one that retards the mentioned interactions ~~discussed above~~. Thus, a more effective barrier ~~coating~~ layer shows a smaller change in contact resistance values when exposed to normal application temperatures over time -- the simulated aging process.

WORKING EXAMPLE 5A

Copper alloy strips were coated with 15 -20 micro-inch thick Ni or Co barrier ~~coatings~~ layers and samples were aged in air at ~~150F~~ 150 degrees C for various times as shown in Table 8 below. Table 8 ~~showed~~ shows that barrier ~~coating~~ layers made ~~by a material~~ of cobalt ~~of the present invention was~~ were more effective than the Ni barrier layers as ~~its~~ the contact resistance for the cobalt barrier layers changed at a slower rate than ~~that of~~ for the Ni barrier ~~coating~~ layers.

TABLE 8

Aging time at ~~150F~~ 150 degrees C, Hrs.	100 gm contact resistance, Ni barrier	100 gm contact resistance, Co barrier
0 (as -received)	3.8 m.ohms	2.67 m. ohms
168	12.8" "	5.43 " "
504	72.4 " "	17.4 " "
1008	92.0 " "	28 " "

PAGE 11, amend the first to third paragraphs as follows:

Following the application of 15-20 micro-inch of Ni or Co barrier ~~coatings~~ layers, the copper alloy samples were finish coated with a 5 micro-inch layer of Au. The samples were aged in air at ~~150F~~ 150 degrees C for different times and their contact resistance values were measured as a function of aging time as shown in Table 9. Table 9 again ~~showed~~ shows that barrier ~~coating made by a material of~~ layers containing cobalt ~~of the present invention was~~ are more effective than the Ni barrier ~~as its~~ layers with respect to rate of change of contact resistance ~~changed at a slower rate than that of the Ni barrier coating~~.

TABLE 9

Aging time at ~~150F~~ 150 degrees C, Hrs.	100gm contact resistance, Ni barrier+ Au finish	100gm contact resistance, Co barrier+ Au finish
0 (as -received)	1.89 m. ohms	0.68 m.ohms
168	1.71 " "	0.68 " "
504	3.49 " "	1.76 " "
1008	5.06 " "	1.25 " "

WORKING EXAMPLE 5C

Following the application of Ni and Co barrier ~~coatings of~~ layers 15-20 micro inch thick, copper alloy strips were coated with a 40-50 micro-inch thick Sn-Pb alloy finish coating 18. The samples were aged in air at ~~250F~~ 250 degrees C and their 100 gm contact resistance values were measured as a function of aging time as illustrated in Table 10. Table 10 again ~~showed~~ shows that barrier ~~coating made by a material of~~ layers containing cobalt ~~of the present invention was~~ were more effective than the Ni barrier ~~as its~~ layers over time with respect to contact resistance ~~changed at~~

~~a slower rate than that of the Ni barrier coating~~.

Table 10

Aging time at ~~250F~~ 250 degrees C, Hrs.	100gm contact resistance, Ni barrier+ Sn-Pb finish	100gm contact resistance, Co barrier + Sn-Pb finish
O(as -received}	0.654 m. ohms	0.98 m.ohms
168	5.15 m. ohms	2.28 m.ohms
504	26.2 m.ohms	1.78 m.ohms
I008		2.36 m.ohms

PAGE 15, amend the abstract as follows:

A ~~metal contact for a~~ copper or copper alloy ~~surface, comprising:~~ ~~electroplated~~ electrical contact member is treated by electroplating a barrier layer on a contact surface of the member, the barrier layer having a thickness ranging from about 0.00001 inch to about 0.0001 inch, ~~wherein~~ and the barrier layer is selected from the group consisting of cobalt, cobalt-nickel alloys, cobalt-tungsten alloys, cobalt-nickel-tungsten alloys, and rhodium. An outer finish layer is coated over the barrier layer, and the finish layer is selected from the group consisting of tin, gold, palladium, platinum, silver, and alloys thereof, so that the electrical contact resistance of the treated contact member does not exceed about 10 milliohms at 100 grams contact force over a period of at least 1000 hours, and at a temperature of at least 150 degrees C.